4. Precipitation Rate Estimation Based On Specific Attenuation

Stephen Cocks

(Evaluated In HWT Hydro Experiments)

Over the past seven years, the Multi-Radar Multi-Sensor (MRMS) system has demonstrated success in improving precipitation estimates across the contiguous United States. The success is built upon the use of radar reflectivity mosaics, mitigation of bright band contamination, and the use of radar echo characteristics and model data to classify echoes and assign a unique reflectivity-to-rain rate (Z-R) relation to estimate precipitation rates. However, Z-R relations are sensitive to drop-size distribution (DSD) changes and the assigned Z-R relation may only be useful for a range of DSDs. Hence, a mis-match between an applied Z-R relation and the DSD of the environment can result in quite significant errors. In 2011, the Dual Polarization (Dual Pol) upgrade to the Weather Surveillance Radar 1988 Doppler (WSR-88D) network opened the way for estimating precipitation in new ways utilizing information provided by Dual Pol data, such as differential reflectivity (ZDR) and specific differential phase (KDP). However, calibration challenges with both Z and ZDR, as well as coarser resolution and inconsistencies in rain rates associated with KDP remain to this day.

To further improve MRMS precipitation estimates, rain rate relations that are not as sensitive to the above listed challenges need to be developed. In recent years, studies have shown potential in using specific attenuation (***A***) to improve precipitation estimates. There are several advantages and limitations of using ***A*** fields to estimate rainfall: 1) ***A*** fields are a measure of radar beam attenuation primarily due to the presence of rain and are more directly related to water droplet concentration; 2) specific attenuation rainfall estimates [R(A)] are also less affected by partial beam blockage; 3) rainfall estimates using ***A*** fields are less affected by reflectivity (Z) and differential reflectivity (ZDR) calibration issues. This talk is focused on the development of an algorithm that utilizes specific attenuation to estimate precipitation, of which the methodology and results will be discussed. Further, this initiative has led to the development of a new MRMS Dual Pol synthetic quantitative precipitation estimate (QPE) product which utilizes specific attenuation below the melting layer, KDP in areas where hail is suspected, and reflectivity within and above the melting layer to estimate precipitation. There are plans for the new QPE product to be part of a multi-QPE evaluation utilizing forecasters within a testbed environment during FY18.